

WHAT IS CLAIMED IS

1. An automatic compliance device comprising:
compliant operating state determining means for determining a plurality of operating states for establishing compliance;
parameter initial value determining means for determining initial values of a plurality of parameters for control of the engine operation for each operating state for establishment of compliance;
compliance target value determining means for determining compliance target values for the plurality of output values; and
parameter complying means for determining adjustment sequences and adjustment directions of a plurality of parameters for reducing output values exceeding compliance target values and sequentially adjusting these parameters in accordance with the determined adjustment sequences in the determined adjustment directions.
2. An automatic compliance device as set forth in claim 1, wherein vehicle specifications, engine specifications, and other information required for establishment of compliance are input when determining the operating states for establishing compliance.
3. An automatic compliance device as set forth in claim 1, wherein values of parameters suitable for the remaining operations are found based on complying parameters for at least one of a steady operation or transient operation in an engine or a steady operation or transient operation in a vehicle.
4. An automatic compliance device as set forth in claim 1, wherein the operating states for establishing compliance are set as points on a map as functions of the torque and engine speed and wherein said compliant operating state determining means determines the intervals of the points on the map and the ranges of the torque and engine speed for establishing compliance.

5. An automatic compliance device as set forth in claim 1, wherein where the operating states for establishing compliance are set as points on a map as functions of the torque and engine speed and where said compliant operating state determining means determines the ranges of the torque and engine speed for establishing compliance based on the torque and engine speed used in a test mode for evaluation of emission.

6. An automatic compliance device as set forth in claim 1, wherein said parameters for establishment of compliance are all or part of a main injection timing, pilot injection timing, amount of pilot injection, common rail pressure, opening degree of exhaust gas recirculation control valve, opening degree of intake throttle valve, and opening degree of variable nozzle of turbocharger.

7. An automatic compliance device as set forth in claim 6, wherein mean values of compliance of parameters of existing engines having specifications corresponding to the specifications of the engine for establishment of compliance are stored in advance and wherein the parameter initial value determining means uses the mean values of compliance as initial values of the parameters.

8. An automatic compliance device as set forth in claim 1, wherein the output values are all or part of the emission, combustion noise, and fuel consumption and the amount of hydrocarbons, and amount of particulate, gas, concentration of smoke or amount of CO.

9. An automatic compliance device as set forth in claim 8, wherein compliance targets of the amount of NOx, amount of particulate, and amount of hydrocarbons, and amount of CO in the output values when running in a test mode equal to cumulative values are overall targets which is for evaluation of emission and where the compliance targets of the remaining output values are target values in each operating state for establishment of compliance.

10. An automatic compliance device as set forth in claim 9, wherein compliance targets of output targets in each operation state are determined for output values having overall targets so that the cumulative values of the output values when running in the test mode become less than predetermined development targets.

11. An automatic compliance device as set forth in claim 10, wherein the ratios of output values per unit time and unit engine output in each operating state with respect to mean output values per unit time and unit engine output when running in a test mode at existing engines having specifications corresponding to the specifications of the engine for establishment of compliance are stored for each operating state, the mean target values per unit time and unit engine output when the cumulative values of the output values when running in the test mode become development target values are calculated, and the compliance target values of the output values in each operating state are calculated from the mean target values and corresponding ratios.

12. An automatic compliance device as set forth in claim 11, wherein the cumulative values of the output values when running under the test mode are calculated under the assumption that the output values of each operating state become the calculated compliance target values and the compliance target values of the output values in each operating state are corrected so that the cumulative values become not more than the development target values when the cumulative values exceed the development target values.

13. An automatic compliance device as set forth in claim 1, wherein said parameter complying means sequentially adjusts the engine in each operating state using initial values of parameters determined by the parameter initial value determining means and wherein the adjustment sequences and adjustment directions of a plurality of parameters for reduction of the exceeding

output values are determined when there are output values exceeding the compliance target values at that time.

14. An automatic compliance device as set forth in claim 13, wherein the compliance values of existing engines having specifications corresponding to specifications of an engine for establishment of compliance are stored in advance and wherein the ranges of search of the parameters for compliance are made the ranges of standard deviation about mean values of compliance of existing engines.

15. An automatic compliance device as set forth in claim 14, wherein the ranges of search of parameters are corrected in accordance with the extents by which the output values exceed the compliance target values when operating in each operating state using the initial values of the parameters and the ranges of search of the parameters are made narrower the smaller the extent of excess.

16. An automatic compliance device as set forth in claim 13, wherein the relationships between the output values and the adjustment sequences and adjustment directions of the parameters to be adjusted when the output values exceed the compliance target values are stored in advance and wherein the adjustment sequences and adjustment directions of the parameters are determined based on these relationships when output values exceed the compliance target values.

17. An automatic compliance device as set forth in claim 13, wherein the relationships between the plurality of output values and the adjustment sequences and adjustment directions of the parameters to be adjusted when the plurality of output values exceed the compliance target values are stored in advance and wherein the adjustment sequences and adjustment directions are determined based on the relationships in accordance with the deterioration of these output values.

18. An automatic compliance device as set forth in

claim 13, wherein the relationships between the output values and the adjustment sequences and adjustment directions of the parameters to be adjusted when the output values exceed the compliance target values are stored in advance, it is judged that output values are in a tradeoff for a common parameter to be adjusted when a plurality of output values exceed the compliance target values, and the parameters to be adjusted and the adjustment sequences and adjustment directions of the parameters are determined based on that judgment.

19. An automatic compliance device as set forth in claim 18, wherein when a plurality of output values exceed the compliance target values, the output values of the top two extents of deterioration are extracted from these output values and it is judged whether or not these two output values are in a tradeoff.

20. An automatic compliance device as set forth in claim 18, wherein when output values are in a tradeoff with respect to a common parameter, the parameter is not adjusted and the other parameters differing in adjustment sequence are adjusted in order from the parameter with the earlier adjustment sequence and other parameters with the same adjustment sequence are adjusted in order from the parameters for output values with high degrees of deterioration.

21. An automatic compliance device as set forth in claim 18, wherein when output values are not in a tradeoff with respect to a common parameter, parameters differing in adjustment sequence are operated in order from the parameters with the earlier adjustment sequence and parameters with the same adjustment sequence are operated in order from the parameters for output values with high degrees of deterioration.

22. An automatic compliance device as set forth in claim 1, wherein evaluating means is provided for evaluating change in output values when a parameter is operated and wherein said parameter complying means

performs a compliance operation of a parameter in accordance with the evaluation by the evaluating means.

23. An automatic compliance device as set forth in claim 22, wherein said evaluating means evaluates changes of output values using an evaluation function expressing a ratio of the output values with respect to the compliance target values.

24. An automatic compliance device as set forth in claim 22, wherein said parameter complying means continues to adjust the same parameter when it is evaluated that the output values when adjusting parameters are declining in trend.

25. An automatic compliance device as set forth in claim 24, wherein said evaluating means evaluates changes in output values using an evaluation function showing the ratio of output values with respect to compliance target values and wherein said parameter complying means continues to adjust the same parameter when the amount of reduction of the evaluation function is more than a predetermined prescribed value when a parameter is adjusted.

26. An automatic compliance device as set forth in claim 13, wherein said parameter complying means changes the parameter to be adjusted to the next parameter in accordance with an adjustment sequence of the parameters when it is evaluated that the output values have not changed much at all or when the output values rise in trend when a parameter is adjusted.

27. An automatic compliance device as set forth in claim 26, wherein said evaluating means evaluates changes in output values using an evaluation function showing the ratio of output values with respect to compliance target values and wherein said parameter complying means changes the parameter to be adjusted to the next parameter in accordance with an adjustment sequence of the parameters when the amount of reduction of the evaluation function is at least a predetermined prescribed value when a

parameter is adjusted or when the value of the evaluation function rises.

28. An automatic compliance device as set forth in claim 13, wherein when a number of adjustments of parameters or a time required for establishment of compliance exceeds a predetermined setting in a compliance operation for one operating state, priority is given to a compliance operation of output values not having overall target values.

29. An automatic compliance device as set forth in claim 13, wherein said evaluating means evaluates changes in output values using an evaluation function showing the ratio of output values to compliance target values, learns the amount of reduction of the evaluation function when adjusting a parameter, and changes the adjustment sequence of the parameters to an order of the magnitude of the amount of reduction of the evaluation function.

30. An automatic compliance device as set forth in claim 13, wherein when it is judged that the compliance operation has been completed for one operating state, the device shifts to the compliance operation for the next operating state.

31. An automatic compliance device as set forth in claim 1, wherein when the compliance operations for all operating states have been completed, cumulative values of output values when running in a test mode are calculated for output values having overall target values and wherein recomplying means is provided for performing a recompliance operation when the cumulative values calculated exceed development target values or when there is leeway with respect to development target values.

32. An automatic compliance device as set forth in claim 31, wherein said recomplying means extracts operating states satisfying all compliance target values from the operating states for establishment of compliance and lowers the compliance target values of the output values not satisfying the overall target values among the

overall target values in the operating states satisfying all compliance target values.

33. An automatic compliance device as set forth in claim 32, wherein the extents of drop of said compliance target values are determined for each operating state in accordance with a frequency of use at a test mode and the extents of drop of the compliance target values are made larger the higher the frequency of use in the test mode in an operating state.

34. An automatic compliance device as set forth in claim 31, wherein when the cumulative values of output values having overall target values are lower than the overall target values by at least a certain setting, the compliance target values in each operating state of the output values are increased, the operating states where the compliance target values are not satisfied are extracted for outputs other than those output values, and the compliance target values in those operating states are made lower.

35. An automatic compliance device as set forth in claim 1, wherein the output values are all or part of the emission, combustion noise, and fuel consumption, the emission is all or part of the amount of NO_x in the exhaust gas, the concentration of smoke or amount of particulate, amount of hydrocarbons, and amount of CO, the compliance target value of the amount of NO_x is an overall target value which is equal to a cumulative value when running in a test mode for evaluation of the emission, the cumulative value of the amount of NO_x when running in the test mode is calculated, and processing is performed for improvement of the fuel consumption when there is leeway in the cumulative value of the amount of NO_x calculated with respect to the overall target value.

36. An automatic compliance device as set forth in claim 35, wherein a compliance target value for NO_x is set for each operating state for improvement of fuel consumption and the processing for improvement of the

fuel consumption is comprised of processing for increasing the compliance target value of NOx and advancing the fuel injection timing in each operating state for improvement of fuel consumption.

37. An automatic compliance device as set forth in claim 36, wherein it is judged whether each output value satisfies the compliance target value each time processing for improvement of the fuel consumption is performed and processing for improvement of fuel consumption is executed so long as each output value satisfies the compliance target value.

38. An automatic compliance device as set forth in claim 36, wherein it is judged whether the fuel consumption has been improved each time processing for improvement of fuel consumption is performed and when it is judged at least a predetermined number of times that the fuel consumption has not been improved much at all, the processing for improvement of fuel consumption is stopped.

39. An automatic compliance method comprising the steps of:

- determining a plurality of operating states for establishing compliance;

- determining initial values of a plurality of parameters for control of engine operation for individual operating states for establishing compliance;

- determining compliance target values for the plurality of output values;

- determining adjustment sequences and adjustment directions of a plurality of parameters for reducing output values exceeding compliance target values; and

- sequentially adjusting these parameters in accordance with the determined adjustment sequences in the determined adjustment directions.

40. An automobile enabling onboard establishment of compliance provided with an automatic compliance device

provided with compliant operating state determining means for determining a plurality of operating states for establishing compliance, parameter initial value determining means for determining initial values of a plurality of parameters for control of the engine operation for each operating state for establishment of compliance, compliance target value determining means for determining compliance target values for the plurality of output values, and parameter complying means for determining adjustment sequences and adjustment directions of a plurality of parameters for reducing output values exceeding compliance target values and sequentially adjusting these parameters in accordance with the determined adjustment sequences in the determined adjustment directions.

41. An automobile as set forth in claim 40, wherein said automatic compliance device is provided with a vehicle model for outputting output values of a vehicle when receiving as input parameters and wherein said parameters are adjusted based on the output values of said vehicle model.

42. An automobile as set forth in claim 40, wherein actual output values of the vehicle are measured and wherein said vehicle model is corrected based on the measured output values.

43. An automobile as set forth in claim 40, wherein said vehicle model is stored in an exchangeable storage medium.

44. A storage medium for storing in a computer a program for realizing an automatic compliance device as set forth in any one of claims 1 to 38.